SCIENCE

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THE APPEAL OF THE NATURAL SCIENCES[1]

AGAIN the revolving year brings us all together at the opening of the autumn term. And yet not all—no university gathering is ever the same in two successive years. Since last September a thousand and yet again a half a thousand earnest young men and women have left us and have gone to all quarters of the earth to take their places in the world's work. To us who remain their faces have become a cherished memory; their future efforts are a subject of confident trust. Twelve months before there were a thousand and *less* than half a thousand; and as our minds run backward over the earlier years we recall the time when the departing graduates were numbered by hundreds, still earlier by tens; at the very outset, in the small beginnings of colonial days by units. At this the opening of the one hundred and sixtieth year of the institution's life, we hark back to the past more naturally than we would were the year drawing to its close. At Commencement, eyes are turned toward the future; but as we gather ourselves together for renewed effort eyes may be most fittingly for the moment turned toward the past.

It seems a far cry from the Columbia of to-day to the Kings College of 1754, hovered under the wings of Trinity Church in the little colonial town. Much has happened meanwhile and vast changes in conditions, in population and in magnitudes of all sorts have come to pass. But the succession is unbroken. We recognize ourselves to be the end members in a long and honorable line. We may for the moment put our-

[1] Address delivered at the opening exercises of Columbia University, September 24, 1913.

selves somewhat in the frame of mind of the Orientals to whom the worship of ancestors is a vital part of life, and we may endeavor from our line of ancestry to draw strength and inspiration for the year's work.

We can do so the more readily because the newness of these buildings is wearing off. Year after year great meetings have been held in this room until its aspect is becoming familiar and it is associated with the feelings of uplift which great audiences give. Ivy begins to cover our walls; while tradition, inheritance, the priceless influence of the past more and more assert themselves. They are indeed one of the great possessions of the university, to which, amid omnipresent change and newness, despite incomparable improvement and convenience, we are prone sometimes to be less sensible than we ought. Let us then run back to the earlier days in the natural sciences in the old Columbia and let the masters of those times make the first appeal for their beloved pursuits.

A century and a half ago the "natural sciences," as the various branches were collectively called, were given less recognition in systems of education than became the custom later. The very name "natural" is itself an interesting commentary on the habit of thought of the time. There were "natural" and "revealed" religion; "natural" and "intellectual" philosophy; the "natural" man, much to his discredit, was contrasted with the "spiritual" man. Even in my own schoolboy days we studied "natural philosophy" instead of physics. The point of view, bred especially in the cloisters, that there was something vaguely wicked about the great world of the out-of-doors had not been outgrown. All will recall that curious phase of thought, current to a certain degree among the ancients, still more generally developed among the people of the Middle Ages, and still strong among ignorant and superstitious peoples to-day, which ascribes something uncanny, harmful, and even demoniacal to the phenomena of nature. Deep ravines, dark recesses of the woods, gloomy caverns with their hordes of devilish-looking bats, the very darkness of night itself, and many other perfectly innocent and to us irresistibly attractive objects of study were looked upon by our forefathers as things accursed. The old habits survive for us in many a story and legend; they have furnished the charm of operas, as in the Freischütz and Tannhäuser; and they cast an interesting side-light on the men and times of the past. But it has taken many years to outgrow them and their germs are part and parcel of us to-day. Our forerunners in natural science had to contend with them, and they were very real obstacles in the way. They were not without their influence on courses of study and in marking the channels in which the currents of instruction ran.

Education in the old days, as we all know, was chiefly work in languages, literature, mathematics and so-called mental philosophy. The subjective mind was the all-important point of attack. The objective universe gained recognition later.

In the eighteenth century in America, the natural sciences received organized care and oversight first in Philadelphia, then the chief American center of intellectual and social life. Benjamin Franklin founded the American Philosophical Society in 1769, the pioneer of our scientific associations, an ancient but still vigorous body, in which, membership to-day is one of the chief prizes for men of science in this country. Eleven years later came the American Academy of Arts and Sciences in Boston. In 1812 the Philadelphia Academy of Sciences was organized; and five years thereafter the New York Lyceum of

Natural History, now the New York Academy of Sciences, made the fourth of our vigorous scientific bodies. It is extremely interesting to read the books of travelers who visited these three cities in the early decades of the last century and to note their comments upon the meetings of the societies mentioned and upon their collections and general activities. The New York Lyceum of Natural History with its building on Broadway near Spring St. was the scene of many an animated gathering.

There is great satisfaction in noting the attention to natural science which was given in the early days of Kings College. It was really greater than was often the case. President Samuel Johnson, an accomplished classical scholar, constituted the entire faculty when instruction began for eight entering students, July 17, 1754. The next year he was aided by his son William, like himself a graduate of Yale. William Johnson was a fellow or assistant tutor; but the first actual professorship was that of mathematics and natural history, to which in 1757 Daniel Treadwell, a graduate of Harvard, was called. Professor Treadwell, by agreement, taught the senior classes "Mathematics and Natural Phylosophy," and the youngest class, Latin and Greek. The establishment of the medical school ten years later added to the staff a professor of chemistry and the materia medica. When the War of Independence had passed and efforts were made to resume instruction in 1784, the College had an annual income of £1,000. A movement arose to increase this amount and to establish seven professorships, viz., Latin, Greek, moral philosophy, rhetoric and logic, mathematics, natural philosophy and astronomy. We scientific men may note with a wee bit of wicked satisfaction, that it was proposed to give the professors in Latin, Greek and moral philosophy, £100 yearly; the professor of rhetoric and logic, £50; while the three professors in the sciences were each to receive, £200. During the closing decades of the eighteenth century, instruction was also given in geography, in botany, and, in 1792, a chair was established of "Natural History, Agriculture and the Arts dependent thereon." It was held by Dr. Samuel L. Mitchill, one of the leading citizens of the city, later member of Congress, and first president of the Lyceum of Natural History.

The foundation of the School of Mines, whose fiftieth anniversary we are planning to celebrate next May, placed the natural sciences upon the firmest foundation which they had possessed up to that time; and while we look back to the earlier names of Mitchill, Hosack, Adrain and Torrey with veneration, we feel that in the inner circle of the college and the closely associated enginering school, the names of Egleston, Chandler, Newberry, Rood and Van Amringe are the ones that make the strongest appeal.

The lives and works of those who have gone before exert a very powerful pressure upon us to maintain the traditions and to pass on to our successors in undiminished importance what we have received. But these influences are active only upon those of us who are year after year in the university. They can not furnish the appeal to the young men and women who come to us and to other institutions for instruction. It may not be inappropriate therefore to also consider at the outset of the year the various forces which turn them toward the natural sciences and then the effect of these studies upon minds and characters. It is a subject in which I have long been interested and which I have followed up by the reading of biographies, by conversations with many of the older scientific men and with younger workers. But all of us teach-

ers of science, who for periods of years have had young men come to study with us our favorite subjects, have inevitably noted the various influences which have prompted them to do so.

Some young men are naturally hunters or fishermen and become thereby attached to outdoor life. An obscure inheritance from some far-off ancestor, who was forced to hunt or to fish for the necessaries of life, may ofttimes assert itself. The latent savage in us, in so far as it may revive and lead to a life in the open, is to be cultivated and developed rather than to be suppressed and bred out. No one, young or old, can roam the woods or fish the streams, the lakes or the ocean, without forming a profound attachment for these surroundings. The pastime of the free days of youth brings into the field of view possible subjects of study for maturer years and occasionally for a life-work. If a youth possesses a studious, thoughtful and reflective type of mind, he is drawn well-nigh irresistibly to continue in these ways. Dr. Henry van Dyke, in one of his charming sketches, describes the taking of his first trout under the guidance of his father, and the deep impression which it made upon him. So many similar experiences followed, with close comradeship between father and son, as to lead our delightful author to wonder, in a mood of whimsical and touching fancy, if somewhere in the Elysian Fields of the future the comradeship will not be resumed. One can not but suspect that it must have been a close decision in his early life whether the youthful van Dyke should become a clergyman or a naturalist; or, as the result proved, a happy combination of both.

Some young men have not roamed the woods or fished the streams for sport in their earlier years, but have been naturally of observant and accurate habit of mind and have been accustomed to note likenesses and differences. The plants, the animals, the minerals and rocks have been the objects to which they have turned and upon which they have exercised their efforts. From an early and close acquaintanceship with a limited area they have begun to wonder about the world outside. The longing to know more fully has brought them to the lecture rooms of the university.

Some are natural collectors and bring together minerals or plants or the smaller forms of animal life in private cabinets. Many a lad has worked by himself over his little herbarium, his trays of minerals or butterflies or birds or beetles until the interest thereby aroused has shaped his future life-work. The beauty of crystal form or of plant structure has appealed to a few more susceptible natures and has drawn them to the study of objects whose attractions seemed irresistible. There are, moreover, from time to time, teachers born into the world—men and women with the gift of clear exposition and with the irrepressible call to shape their lives so as to give it free scope. Some turn to languages; some to the subjective thought of the past; some to moral, religious or economic instruction; and some to preach the gospel of the out-of-doors and of the world of nature.

Some men, especially amid the mountains or in the desert regions such as we find in our western states, are born and reared amid the grand and striking phenomena of nature. Great gorges, abrupt precipices or barren wastes may well raise in their minds the desire to know more about these phenomena. We always find the people in such surroundings reflecting on the causes of things about them and groping for their explanation, it may be blindly, until taught the results laboriously attained by earlier students and until they are steadied by the accumulated results of many observers. There are in other regions young men of

naturally inquiring type of mind, human interrogation points, with a consuming desire to discover the reason of things. The currents of human life and action sometimes attract them less than the phenomena of nature. They turn to the latter as the proper objects of their effort. If endowed with that happy but rare combination of an ability to reason logically and closely and yet to let imagination have its revealing play, they may advance the outposts of knowledge in no small degree.

Let me illustrate by the lives of two or three geologists, selecting them because they are less familiar than the youth of some of the more widely known names in other branches and are therefore possessed of freshness and newness. James Hall, our famous New York state geologist of other days, was a lad in Hingham, Massachusetts, near Boston. Hearing that a school had been started near Troy, N. Y., where natural sciences were especially taught, and having slender resources, he walked from Hingham to Troy and began his studies. He roamed the hills around the little city of the upper Hudson valley, collected the plants and animals, became a teacher in the school and ultimately the official of this and other states. He devoted his mature years to the description and illustration of the dead and gone life of the past with such skill that his works are among America's greatest contributions to science. Peter Lesley, the famous state geologist of Pennsylvania, was a graduate of the Andover Theological Seminary. From failing health he gave up a settled pastorate and became a distributor of bibles in the remoter hills of New Jersey and Pennsylvania. Walking from cabin to cabin of the mountaineers, his eye caught the wonderful geological structure displayed in this region and he turned to natural science; never losing, however, that love of his fellow man which first directed his steps to the mountains as a colporter of sacred books. Newberry, our old-time and distinguished professor, was a boy amid the coal mines owned by his father in eastern Ohio. The wonderfully preserved ferns in the beds associated with the coal interested him profoundly. In later life he tried to curb his natural tendencies and practise medicine in Cleveland, but after five years he gave up the struggle and became naturalist to several successive exploring parties, sent out by the federal government in the West. After the Civil War he was called to be one of the half dozen professors in our School of Mines. He was our first native-born student and describer of the floras of past geological time.

There come also to our class-rooms young men of able and gifted minds, but as yet with no positive inclination toward any special line of work. The influence of some teacher who has the divine fire may arouse latent interest and ambition so that a career of good and serviceable work opens out. To this last group who enter the class-rooms without special call for the future and whom a teacher can influence for a few months, it is all-important, whether they follow science or not, to present in addition to the hard facts of the subject as many of its great truths and generalizations as possible. We should leave some deep imprint which they can never forget. The conception of the earth, for example, as the product of the long, long interplay of many forces, is one which can be readily driven home. The rise and fall of continents, the advance and retreat of oceans, the records of the more recent, and then of the remoter, and finally of the most ancient past, which have now been brought into orderly sequence, convey an impress which, once stamped, can never be effaced. When, therefore, the future lawyer, physician,

clergyman or merchant travels and looks upon mountains, plain and ocean, they mean something to him, and his intelligence grasps them in a way not only to add to his enjoyment, but to make him a broader-minded and better member of human society.

The effects are the same with other branches of natural science. Even from elementary work with plants and animals, some grasp can be gained of their kinds and local associations. Some standard of comparison with other regions is afforded such that by an observant eye intelligent parallels can be drawn. No one who has even a superficial knowledge of the plants and trees in our northern states can travel in the north of Europe without being constantly reminded of his home surroundings. The little twin flower, *Linnæa,* growing on the sands and glacial boulders of our northern and Canadian mountains, has removed the homesickness from the heart of many a Scandinavian settler and has made him feel as if the world was very narrow, after all. And thus arise the questions of animal and plant dispersion. Why is it that they are so nearly the same on opposite sides of the ocean or that one little vine, with the most delicate and fragrant flowers imaginable, can girdle the earth in its northern latitudes?

Again, if with collections and with field experience we can bring home to an intelligent student that one species of plant or animal shades off through close relatives and similar varieties into others and so on to others more remote, so that, although we recognize the entire unlikeness of the widely separated members, we hardly know where to mark a break in the series, a new and startling view of nature is gained. Or, if we find difficulty in bridging some of the gaps among the surviving species on the earth to-day and appeal to the evidences of the fossil past so as to show converging lines of ancestry, the organic world takes on new aspects and an orderly, reasonable and understandable character, not possessed before.

The strongest, most striking, and most readily received impression of all is the one given by the heavens. The sun and moon, the planets and the more distant fixed stars, set as we know them to be in orbits capable of exact mathematical expression; open to our view in all parts of the world; equally visible from land or sea; and best of all in the clear atmosphere of the desert; make the profoundest impression and the strongest appeal of all the branches of natural science. The enormous distances, the order and precision, the series from glowing nebulæ to dead, cold bodies, the vast stores of energy radiating into space, stimulate an inquiring mind as does no other branch of natural science. We are face to face with the origin and development not alone of one world, but of many worlds, indeed of the universe itself.

But there is one additional appeal from the natural sciences which in a fairly new and rapidly developing country like our own is particularly strong to the minds of young men. It was not altogether by chance that the natural sciences received recognition in the medical school of Columbia College in 1767 nor that they were first placed solidly on their feet with the establishment of the School of Mines in 1864. The appeal is based on their useful applications and the assistance which they can give to the practise of medicine and surgery and to all branches of engineering and manufacturing. There was formerly a disposition to think lightly, sometimes even scornfully, in university circles of the applications of our natural sciences and to conclude that if a professor or student once became influenced by them he lost his ideals

and his devotion to pure investigation. But I think we have outgrown this narrow point of view. Not so very many years have passed since the brilliant course of lectures delivered at this university by the late Professor James, in which he set forth the principles of pragmatism. That is, if I understood them correctly, he applied to systems of philosophy and all manner of doctrines very much the same tests that we use for all sorts of useful devices. Will they work? Will they do good service? Are they worth while? Some have at once concluded that pragmatism restricts idealism and minimizes respect for grand truths which stand eternally whether they are of service to mankind or not. Possibly in connection with the last results of mathematical reasoning there may be ground for the criticism. On the other hand, there is much to be said in favor of the check which the pragmatic point of view puts upon vain and idle lines of thought, leading nowhere; in favor of the curb placed upon the putterer in the fields of intellectual activity; or, to use another figure, in favor of the jetties by which it keeps the current of thought in safe and deep channels. Our colleague Professor Fullerton has shown in his recent stimulating work, that in all philosophical reasoning we must take into account that great body of human experience and its resulting influence on habits of thought, which is the common heritage of every man. To be intelligible and to exercise an effective influence, the work of a teacher is blocked out by these all-important considerations.

It is no reflection on the natural sciences, therefore, that they do good service to our modern civilization, nor need the students and teachers of them feel otherwise than proud that their studies have been of service to mankind. The investigator into the minute forms of life, whether of plant or animal, has often found his inspiration in the hope that his results might decrease disease and relieve human suffering. The worker upon the larger forms of plants and animals has multiplied in extraordinary degree the foodstuffs and fabrics. The close study of minerals and their occurrences in nature has added to our mines and supplies of the metals. Even the very fossils in the rocks, the type and symbol in the minds of many for the useless and the negligible, have in the hands of the geologist been of indispensable assistance in selecting the best course for a great, new aqueduct which is to supply our metropolis with its necessary water.

Now the belief that what a student learns, both of scientific fact and doctrine, will be of service to him in his future profession in medicine, engineering or kindred lines, is a very strong and a very worthy appeal. It draws not a few to our courses of study and makes of them diligent workers in the class room and laboratory. That instructor will gain the best results who, while abating in no particular the thoroughness of his presentation, yet slips in the pregnant illustration, which from time to time ties up his subject with the future work of his students. We thus exemplify the truth of the doctrine, expounded in its most general form by Professor Fullerton, that for results we must consider that great body of accumulated experience which has shaped our habits of thought.

In referring to the useful, I do not mean to limit the field merely to the satisfaction of material wants. To enlarge the life of the spirit is, when gaged by its results, as beneficial a service to humanity as to feed the hungry, clothe the naked or relieve the suffering. But the final values are determined by the fruits.

While I have spoken of the connections

between the natural sciences and the professions of medicine and engineering, there are many points of contact between the student of nature and the artist on the one side and the poet on the other. As between the first two there is the consuming ambition to faithfully depict what one has seen. The scientist does it with descriptions, fortified more and more in later years with pictures. The descriptions reproduce for a person at a distance the object before the actual observer. They record for the future the fleeting things of the present. In so far as the artist deals with the actual rather than the imaginary, his ambition is likewise to give true and accurate impressions, and by his medium of expression to convey his thought to others. The record is indeed not for comparison with the original at some future time, as it is with the scientific man, and it appeals rather from its own intrinsic merits than because it places objects in systems of classifications or shows them to conform to law, but the inspiring motive or ideal which holds each to the proper fulfilment of his task is the same. Wielders of the brush or of the chisel often become as thorough masters of bone, muscle and form as the professional anatomists themselves. The portrayers upon canvas of mountains and canyons must be true to geological structure as much as if they were geologists. Ruskin, you will recall, has emphasized this truth in one of his essays. Sometimes the portrayer of landscapes and the geologist strike hands and work together. Thomas Moran, the artist, was in the party of Clarence Dutton, the geologist, when the Grand Canyon of the Colorado was studied thirty years ago. They greatly aided each other and sometimes when we read the word-painting of Dutton and view the color-portrayal of Moran, we hardly know which was the greater artist. Certainly both were profoundly moved by their surroundings and singularly gifted, each in his own medium of expression.

One soon learns from the lives of geologists that over and over the masters of the subject have turned to their sketch-books and pencils to faithfully record what they saw in the field. The excellence of the portrayal leaves us sometimes in doubt whether they were the more artist or scientist. Indeed, we may wonder, if after all when the real master appears the two terms are not synonymous. Deep down in the fundamental inspiration of each you will find an identical substratum.

The close relations between the student of nature and the poet, I fancy, you will find less easy to establish, and yet there is much in common. The parallel may be first drawn between the means of expression. The music of verse is based upon orderly mathematical relations as much as the music of notes. In fact the two are not far apart in this primary feature, and the appeal of each to the ear is based on the fondness of our minds for just this orderly arrangement of sounds and accents. The order and the harmony are necessary; otherwise we are in revolt. The student of plants, animals or minerals seeks to classify them all in natural and related groups. The relationship, the conformity to law, the harmony thus displayed are what appeal to him. Through drudgery, hardship, effort without limit, they carry him unfalteringly to his goal. The geologist seeks the laws which govern the phenomena of our material earth; while the astronomer deals with the forces of attraction which bind the universe in a united whole. The words of a poet and the phenomena of a naturalist fall into very similar relations. But back of the words of the poet and back of the phenomena of the naturalist, there must be in the mind of each an insight into the meaning of things, which is a very rare and very

great gift. Fullness of experience and broad knowledge of the phenomena of human life on the part of the one—equally broad and comprehensive grasp of the phenomena of nature on the part of the other —lead to revelations of otherwise unsuspected truths.

We are not without illustrations. It is really quite impressive that when we come to know the lives of geologists intimately, we very often find them expressing themselves in verse. I doubt not, if we could have access to their notebooks, recorded in the field, we would find many a stanza, in which amid grand scenery the geologist sought to give utterance to the emotions which filled him. Some have actually gone to press. The verses of Perceval, the old-time state geologist of Connecticut and Wisconsin, fill a volume in the works of earlier American writers. Throughout the "Life and Letters of Sir Andrew Ramsey," the late chief of the Geological Survey of Great Britain, we find now a sonnet, again a song, in which his feelings found irrepressible outlet. Only a few years have passed since the late Professor Shaler, the man of great heart and boundless sympathies, long in the chair of geology at Harvard, gave us five entire volumes of dramas, reproducing the Elizabethan period, and all in verse. His thought found metrical expression with great ease and fluency. His geological training, with its broad sympathy with nature, was far from an inappropriate preparation for the task. To come nearer home, we will many of us recall that from the severe mathematical and scientific training of our School of Mines, have come two of the most graceful and appealing of our modern American writers of verse. It is rare that stanzas go so straight to our hearts as do theirs. Indeed, unless the student or investigator of scientific problems has in his composition some infusion of the divine fire, his work never rises above the humdrum and the commonplace. He *must* at times feel his heart burn within him as he walks the ways of his chosen calling.

Many, as I have mentioned, follow courses of study in the natural sciences from interest in the subjects, but the student can not do so without a reflex influence upon himself. He is, for example, obliged by the very nature of the pursuit to be accurate, precise and orderly in his thinking. False observations, careless records or confusion of thought bring no results. Clearness and a remorseless regard for the truth must be all-absorbing. There is and can be no attempt to make the worse appear the better reason; there is no complexity of motive; but simple and direct habits of mind must be cultivated. Results are to be reported to others and are certain to be checked in the future. There is therefore the constant pressure to have them right. An ideal is held before a man which is not without its ethical response. While one can not say that it is always manifested in the lives of scientific men with all the force that we might wish; nor can we say that every one of them is as truthful, direct or accurate as he should be, yet the influences of his pursuits are strong, even if not altogether transforming.

The natural sciences, when not pursued as a life-work, exercise in other respects a most wholesome influence. They serve as a change from other work and as a foil to complete absorption in ordinary employments. People in general are too exclusively occupied with matters which concern their own kind alone. It becomes easy to regard man as the end and object of the universe, the old conception of the teleologists. The dwellers in crowded cities tend to be concerned solely with human, purely human affairs. Brick-walls and pavements,

the clothing, feeding and housing of men, women and children make up the entire round of life, so that for their use the world may have naturally seemed created. This is an ancient and charmingly child-like conception. But when we know something of the earth's complexity, of its wonderful inter-relations, of its long past and of the certain developments through which it will pass in the future, these false notions give place to much more correct perspectives. Man is indeed a member of the great, organic family, but he has his place in the series, just as do all the other members. He plays his part, but so do they. In some respects he is more impressive than other living creatures; in some respects less so. A well-balanced student of natural science accepts these facts and draws no comparisons of superiority or inferiority. He has borne in upon him the conviction that human affairs are not all of the universe, and that he should be neither unduly exalted nor cast down. A calm and steadfast habit of mind should be his and his studies should exercise this disciplinary influence upon him.

The American who has given the best expression to this influence of nature upon man is Bryant. Himself a keen lover of the woods, fields and mountains, he had further the great gift of describing in dignified and musical verse their effects upon him. In his "Forest Hymn" and again in "Thanatopsis" we find these influences beautifully set forth. The calm philosophy which places one apart from the small bickerings and petty things of life rings true in his lines, so that often the words go coursing through our thoughts when face to face with the sublime phenomena of nature.

Bryant, however, is not alone in giving utterance to these conceptions of life. Many and many a naturalist—to use again as I have several times already this old descriptive term for a student of nature—many a naturalist has felt the same and from time to time has set down in his pages the thoughts regarding a philosophy of life, which sprang for utterance while describing material phenomena. We have had within a few years a monumental work from a venerable and greatly beloved Austrian geologist, Eduard Suess. He has discussed the "Face of the Earth"; that is, he has passed in review the entire surface of the earth; its elevations and depressions; their connection with geological structure and time of production; their characters; relationships; systems; causes. He spreads before us a wonderful panorama and casts a flood of light upon its obscurities. But when he comes to his closing sentences he is reminded that his pages are to be read by men and women, and to have their influence upon human lives. Recognizing, therefore, the problems which have been solved and the many others which remain for the future, he sums up in the following words:

> In the face of these open questions, let us rejoice in the sunshine, the starry firmament and all the manifold diversity of the face of our earth, which has been produced by these very processes, recognizing at the same time to how great a degree life is controlled by the nature of the planet and its fortunes.

J. F. Kemp

Columbia University

OUR RADIUM RESOURCES[1]

The "wonders of radium," both fact and fable, have been treated so extensively in the scientific and public press that it is not my intention, nor is it at all necessary, to repeat them here. Rather it is my wish to-day to present to a body of men interested in the development of American mining the present commercial situation as regards radium and its ores, and to point

[1] Address to the sixteenth annual convention of the American Mining Congress, Philadelphia, October 20–24, 1913.